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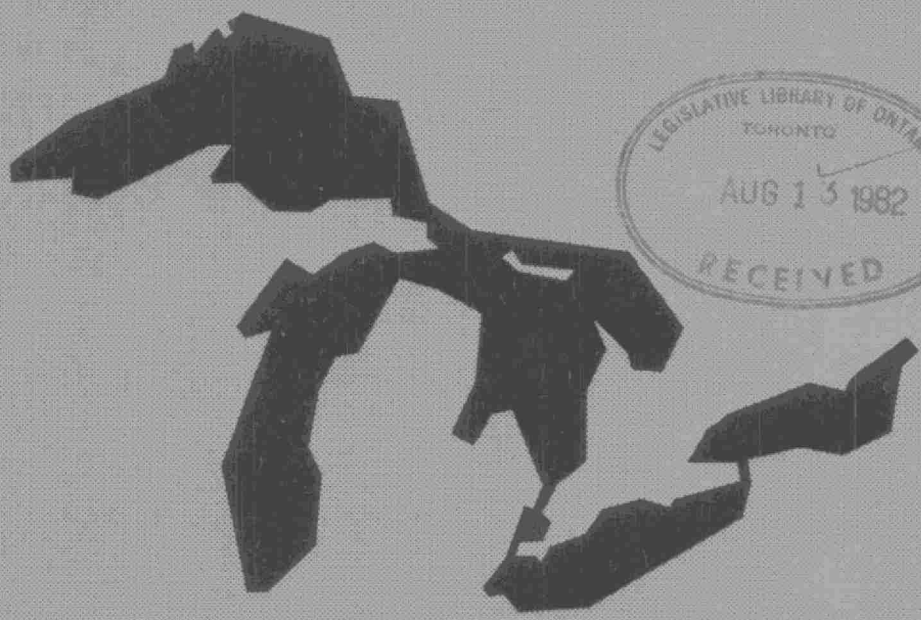


Ministry
of the
Environment

Canada-Ontario Agreement on Great Lakes Water Quality

Ontario

CANADA-ONTARIO
GREAT LAKES SURVEILLANCE PROGRAMS
1980/81



Prepared by the Surveillance Committee
for the Review Board
Canada-Ontario Agreement on Great Lakes Water Quality

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CANADA/ONTARIO
SURVEILLANCE AND RELATED
RESEARCH PROJECTS
1980/81

PREPARED BY THE SURVEILLANCE COMMITTEE
FOR THE REVIEW BOARD, CANADA/ONTARIO AGREEMENT

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INTRODUCTION

When the first Canada/U.S. Agreement on Great Lakes Water Quality was signed in 1972, it established a set of principles which would guide the two countries in the task of preserving and enhancing the water quality of the Great Lakes. The most important of these included:

- (a) the development of water quality objectives to be met in the Lakes;
- (b) the commitment to undertake all reasonable and practicable control programs; and
- (c) the institution of a surveillance and monitoring program which would assess compliance with the objectives, assess the effectiveness of implemented control programs and detect the emergence of new problems.

When the revised Agreement was signed in 1978, it preserved these basic principles, but at the same time broadened the scope of the Agreement and introduced an ecosystem approach concept.

Within the federal government, Environment Canada has been assigned the lead responsibility to ensure that the work required by the Agreement is undertaken. Although much of this work can be undertaken directly by the federal government, a great deal is within the jurisdictional responsibility of the province. The Canada-Ontario Agreement Respecting Great Lakes Water Quality and the Canada-Ontario Accord for the Protection and Enhancement of Environmental Quality are the primary mechanisms whereby the two governments commit themselves to various undertakings. Specifically, The Canada-Ontario Agreement (COA) provides the umbrella for sharing 50% of the cost of provincial surveillance efforts on the Great Lakes. This Agreement is presently undergoing revision to make it compatible with the revised (1978) Canada-U.S. Agreement.

This document summarizes the planned 1980/81 surveillance and related research activities of Environment Canada, Fisheries and Oceans Canada, and the Ontario Ministry of the Environment. The combined federal/provincial effort is directed toward meeting the Canadian responsibilities required in (c) above. The projects are conducted within the framework of the Great Lakes International Surveillance Plan (GLISP) developed by the Water Quality Board of the International Joint Commission (IJC), and within the Terms of Reference of the Surveillance Committee of the Canada-Ontario Agreement.

Briefly these state:

"The Federal Government will concentrate its water quality surveillance activities on the open lake waters and connecting channels to:

- (i) determine compliance with IJC (Water Quality Agreement) objectives;
- (ii) delineate problem areas; and
- (iii) determine long term trends."

The Province's activities will include:

"The assessment of water quality in the nearshore waters of the Great Lakes and in the connecting channels including the evaluation of the impact of Ontario based effluents and emissions for the purposes of:

- (i) delineating areas where Agreement objectives are not being met;
- (ii) identifying the source(s) of degradation and possible remedial measures;
- (iii) providing early warning of emerging problems; and
- (iv) evaluating the effectiveness of remedial action."

Highlights of the 1980/81 Federal Surveillance Program include:

1. Ongoing surveillance of the open waters of Lake Ontario and Lake Huron (including Georgian Bay, Saginaw Bay, and North Channel) under GLISP.
2. Ongoing surveillance of the Niagara River and St. Lawrence River, including daily sampling for loading estimates to and from Lake Ontario.
3. Continued operation of the atmospheric deposition network for measuring atmospheric loadings of contaminants and nutrients to the Great Lakes.
4. Continued investigation of contaminants levels and reproductive success in herring gulls and other fish-eating birds.

Surveillance related research activities of Environment Canada and Fisheries and Oceans Canada at NWRI and GLBL during 1980/81 include:

1. Further development, application and verification of coastal zone transport models and models to support Limited Use Zone assessments.
2. Continued research into the application of in-situ and spaceborne remote sensing systems.
3. Refinement and development of methodologies for the statistical analyses of Great Lakes surveillance data.
4. Ongoing development of predictive aquatic ecosystem models.
5. Related to the issue of contaminants in the Great Lakes fishery; five research studies are being conducted by GLBL which address:
 - (a) tumour monitoring in Great Lakes fish;
 - (b) an investigation of anomalies observed in the testes of Great Lakes trout;
 - (c) monitoring of heavy metals and persistent organic contaminants in Great Lakes fish;
 - (d) the development of a socio-economic data base on the Great Lakes fishery.
 - (e) environmental requirements related to laboratory storage of a biological tissue bank for the retrospective analysis of historical tissue samples.
6. Ongoing development of laboratory procedures and data base for Great Lakes phytoplankton.

Highlights of the Province's 1980/81 program include:

1. Surveillance activity is intensified this year on Lake Huron, Georgian Bay and the North Channel as part of GLISP. Included in this study are efforts directed to nearshore water quality assessment in southern Georgian Bay and the coastal zone of eastern Lake Huron, and localized assessments at Serpent Harbour, Spanish River Mouth, Penetang-Midland and Collingwood Harbour. Also included are baseline inventories of nearshore benthos (whole lake) and of attached algae (Georgian Bay). Weekly sampling of the head ranges of the St. Mary's and St. Clair rivers is being undertaken under GLISP for interlake mass balance. Regular monitoring work on the St. Mary's river is being intensified under GLISP and to monitor the effects of construction at Great Lakes Power.
2. Field work on Lake Erie has been reduced after the two year international field program under GLISP. Activity during this year will focus on the analysis, interpretation and reporting of Lake Erie based on 1978-79 field data. Ongoing monitoring will continue off Nanticoke in eastern Lake Erie and an update study of benthos in the Detroit River is being conducted. Activities in the St. Clair River will focus on phenolic substances near point sources and an investigation of bacteriological problems due to storm drainage off the city of Sarnia waterfront.
3. In the Niagara River, effort will be focused on the identification of sources and the biomagnification of persistent toxic substances. Analysis, interpretation and reporting of previous data are underway and a joint Federal-Provincial report of the COA Surveillance Review Board has been published.
4. Regular monitoring of nearshore Lake Ontario is continuing with an intensive spring cruise and two weekly transects. Detailed investigation of oxygen depletion problems is being conducted near Adolphus Reach in eastern Lake Ontario.
5. Continuing surveillance and follow-up studies are being conducted in known IJC problem areas including St. Mary's River, Serpent Harbour, Spanish River mouth, Penetang, Collingwood Harbour, Wheatley, Hamilton Harbour, Toronto Harbour, Bay of Quinte and the St. Lawrence River at Cornwall.
6. Ongoing programs to support trend evaluation include radioactivity monitoring; stratified tributary monitoring; contaminants in young-of-the-year and sport fish; and Great Lakes municipal intakes.
7. Limited use zone designation will continue, with completion by IJC deadlines. Further work will involve the refinement of models, LUZ verification and updates.

SECTION 1
ENVIRONMENT CANADA AND FISHERIES AND OCEANS CANADA
SURVEILLANCE PROGRAM AND RELATED RESEARCH ACTIVITIES
1980/81

PROJECT TITLE: OPEN LAKE SURVEILLANCE

Background: In fulfilment of commitment to Surveillance Workgroup and Great Lakes Water Quality Board the annual assessment of the offshore waters of Lake Ontario is conducted. Annual surveillance is carried out to detect progressive and long term changes which might be obscured by the highly variable, nearshore, harbour and tributary water quality. This also provides an invaluable gauge against which the effectiveness of pollution abatement measures can be evaluated.

In accordance with the schedule outlined in the Great Lakes International Surveillance Plan (Table 1), intensive surveillance is being conducted on Lake Huron, including Georgian Bay, the North Channel and Saginaw Bay to provide continuing information on water quality conditions.

Objectives: The objectives of annual surveillance on Lake Ontario are:
 (a) to detect and report violations of specific water quality objectives under the 1978 Great Lakes Water Quality Agreement;
 (b) to relate changes in the physical, chemical or biological character of Lake Ontario to the effects of remedial programs, if possible.

The objectives of intensive open lake surveillance on Lake Huron are:

- (a) to provide sufficient information to permit a detailed assessment of main lake conditions;
- (b) to detect new or emerging problem areas which may affect the water quality of the lake;
- (c) to aid in model development, calibration, verification and application.

Saginaw Bay is studied to document changes in eutrophication-related parameters in response to phosphorus reduction in the Saginaw Basin; to permit a detailed assessment of conditions and trends, and to examine general water movement and exchange.

Scope: The Lake Ontario annual surveillance program consists of 3 full-chemistry cruises, two in early spring (March-April) and one in October. Ninety-four stations will be sampled (Figure 1) emphasizing those parameters with specific objectives in the Water Quality Agreement of 1978, including phosphorus, oxygen, total dissolved solids and pH.

The Lake Huron intensive surveillance program is being done in conjunction with US EPA and entails 6 cruises between April and November, 1980. There are 71 stations on the main lake, 44 on Georgian Bay and 22 in the North Channel (Figure 2). Sampling will be done for nutrients, major ions, trace metals, organic contaminants and aquatic biology. In sampling such an extensive spectrum of parameters, a statistically valid assessment can be made for each lakewide issue being addressed.

On both Lakes Ontario and Huron, detailed sampling is done to provide information which will assist in the development and application of predictive techniques for each lake.

Twelve 5-day cruises will be conducted on Saginaw Bay at approximately 18-day intervals from April to November. Thirty-four stations are sampled for eutrophication-related parameters, including zooplankton and phytoplankton.

Surveillance of Lake Huron - Georgian Bay and Saginaw Bay requires continuous communication between Canadian and American agencies, both federal and provincial/state. Every detail of sampling and analysis is defined to prevent duplication of effort, insure data comparability and minimize interlaboratory analytical variability.

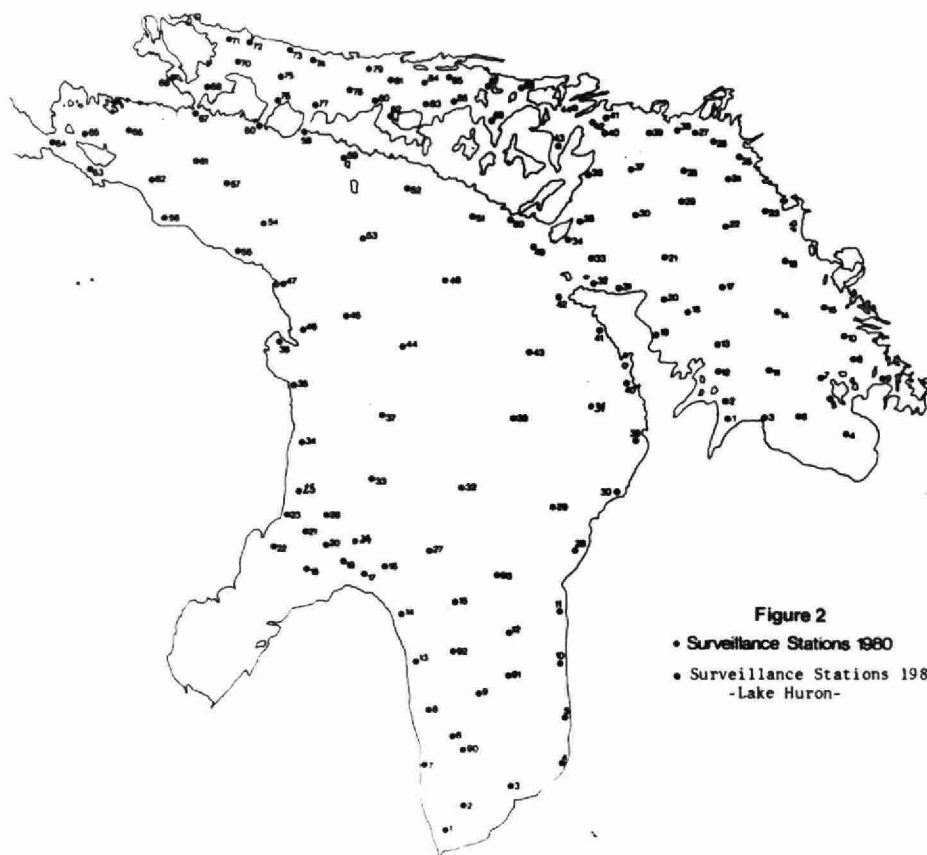
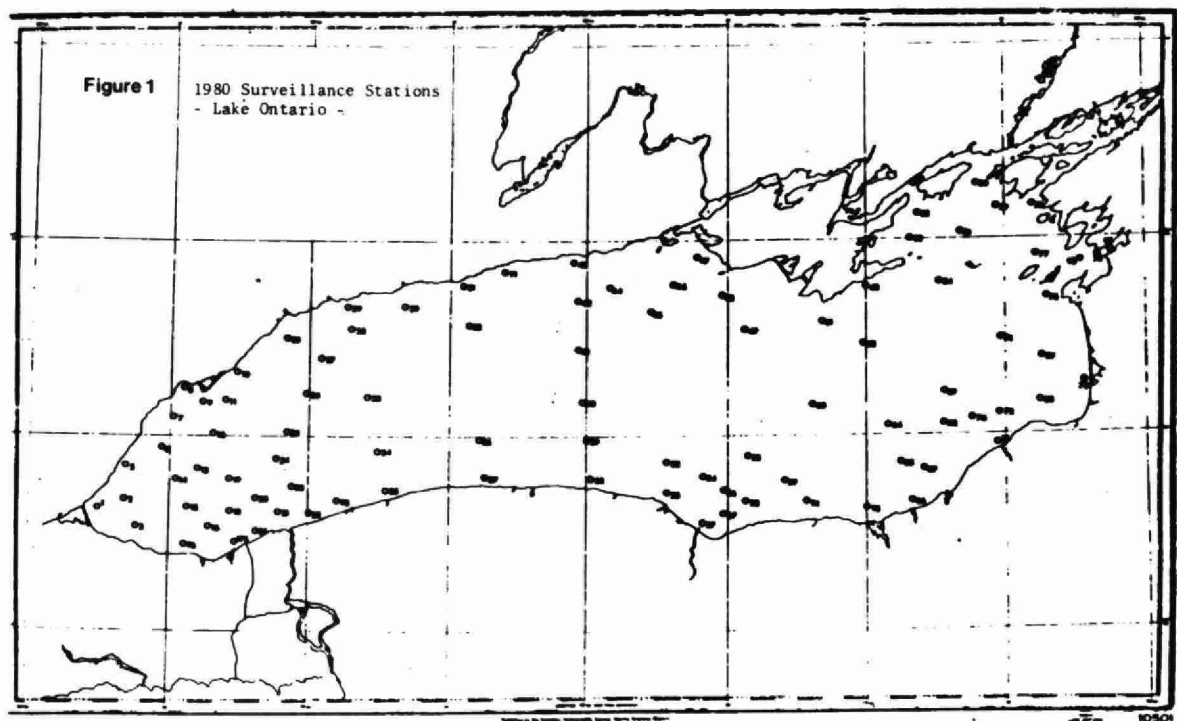
Output: A report summarizing (1) state of Lake Ontario in 1980 (2) trends and (3) violations of agreement objectives to Surveillance Workgroup of IJC.

A similar report for Lake Huron and Saginaw Bay including:

- (a) an evaluation of trace metal and organic contaminants in the lake and possible sources; and
- (b) an evaluation of the current sampling program and recommendations for future whole lake surveillance.

TABLE 1
GREAT LAKES INTERNATIONAL SURVEILLANCE PLAN INTENSIVE SCHEDULE

Design Component	1978	1979	1980	1981	1982	1983	1984	1985	1986
MAIN LAKE - INTENSIVE									
Lake Superior						X			
Lake Michigan								X	X
Lake Huron			X						
Lake Erie	X	X							
Lake Ontario				X	X				
NEARSHORE - INTENSIVE									
Lake Superior						X			
Lake Michigan								X	X
Lake Huron			X						
Lake Erie	X	X							
Lake Ontario				X	X				
CONNECTING CHANNEL - INTENSIVE									
St. Mary's River			X					X	
St. Clair River	X					X			
Lake St. Clair			X				X		
Detroit River	X					X			
Niagara River			X						
St. Lawrence River				X					



PROJECT TITLE: CONNECTING CHANNEL SURVEILLANCE

Background: GLISP specifies on-going efforts to detect violations of water quality objectives within the connecting channels as well as measuring loadings, particularly for phosphorus.

Objectives:

- To detect and report violations of specific water quality objectives under the 1978 Great Lakes Water Quality Agreement.
- To establish trends in physical, chemical and biological characteristics.
- To monitor persistent toxic substances in water and sediment and identify any trends.
- To establish a sediment bank to permit retroactive analysis for trends.

Scope:

In 1980 to evaluate a new organic sampler for use in the field.

Automated daily sampling on the Niagara and St. Lawrence Rivers will be continued to provide data for loading estimates to and from Lake Ontario.

In addition, the Niagara River program will include biweekly analysis of composite water and suspended sediment samples for PCB's and organochlorines and quarterly analysis of sediment for PAH's, phthalates and organic scans. The sediment bank will be maintained.

An intensive study will be undertaken at Niagara on the Lake to collect suspended sediments continuously for a seven-day period to more accurately define IJC violations of PCB and chlorobenzene objectives.

Connecting channels surveillance requires continuous dialogue between federal and provincial agencies. Field programs are defined before every field season and co-ordinated so that no duplication of effort occurs.

Output:

The annual material loadings to and from Lake Ontario will be calculated.

Emphasis will be on analysis of organic contaminants data from Niagara on the Lake and a report summarizing results of the Upper Niagara River surveys conducted in 1979.

PROJECT TITLE: ATMOSPHERIC LOADING

Background: To accurately quantify loadings to the Great Lakes, an estimate of the atmospheric deposition of various substances is needed. Having recognized the need for this information, a precipitation sampling network consisting of 16 stations in the Ontario Region of Environmental Canada was established pursuant to the Great Lakes International Surveillance Plan (Figure 3).

Objective:

- To determine loadings to the Great Lakes via direct atmospheric deposition, both wet and dry.
- To identify trends in the chemical composition of atmospheric deposition and the effects of loadings on the Great Lakes.

Scope:

Monthly integrated samples of wet deposition are collected and analyzed for their chemical composition and areal loading rates are calculated as $\text{mg}/\text{m}^2/\text{day}$. The material in the dry deposition container is diluted in a volume of distilled water equal to that accumulated in the wet container. The wash solution is then analyzed and dry deposition rates calculated.

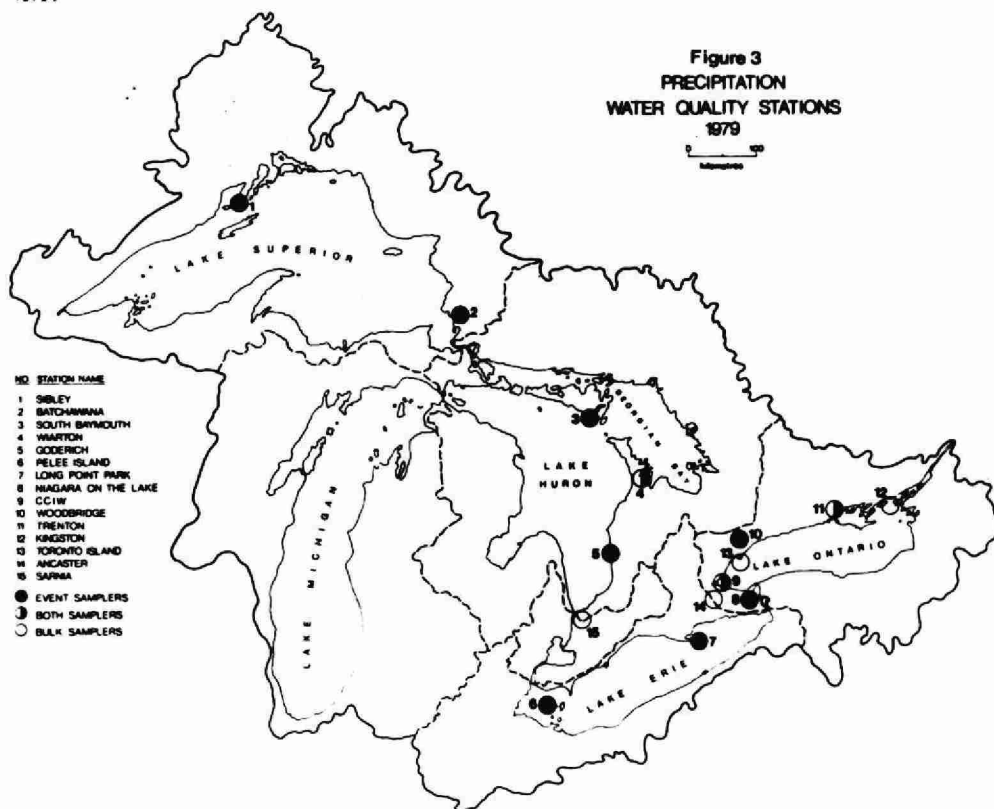
The parameters measured include nutrients, major ions and some trace metals.

Close and continuous co-operation between federal, provincial and US agencies is required. Inter-agency co-ordination (LRTAP, CANSOC/CANSAP, NEMP) assures maintenance of information exchange.

Output:

Estimates of atmospheric loadings to the lakes for each parameter are reported annually to the IJC.

Precipitation chemistry data collected between 1972-1978 in bulk collectors will be evaluated and published.



PROJECT TITLE:	WILDLIFE CONTAMINANTS	Prepare appropriate documented policy proposals and recommendations for management consideration.
Background:	Analysis of contaminant data from 1974 to 1979 has demonstrated the usefulness of the herring gull in reflecting the gradual disappearance of some major contaminants from its Great Lakes trophic web. The high trophic position and integrating capacity of fish-eating birds in general, and the herring gull in particular, allow for a maximum return on the surveillance effort expended. This high trophic position simultaneously permits detection of new compounds when their levels are too low to be detected in water or lesser biota. The herring gull is in effect an early warning system against those xenobiotics which have a tendency to bio-accumulate in all living organisms including man.	Participate in meetings or assume delegated responsibility on internal, departmental and international committees and work groups engaged in the development of plans and policy recommendations in relation to the management of environmental data.
Objectives:	To continue trend analysis of the ten regular monitor colonies throughout the Great Lakes. To report specifically on Lake Huron contaminant problems. To continue reporting on the effects (mostly of a reproductive nature) of contaminants on the herring gull as well as on environmentally sensitive species such as the double-crested cormorant and the caspian tern.	Participate in special studies aimed at the regionalization of data management practices in relation to departmental plans and initiative for the establishment of co-operative, standardized and compatible data processing services.
Scope:	1. Regular collection of eggs as well as serial adult and chick collections. 2. Monitoring of reproductive success through a measure of hatching and fledging success. 3. Determination of the current population status of fish-eating birds in the Great Lakes with special emphasis on the improving double-crested cormorant populations. 4. Refinement of surveillance methods such as the development of heavy metal analysis of feather collections. 5. Further analysis of predictable trends in major-contaminant levels.	Output: Software conversion packages for data system inter-conversion as well as recommendations for future procedures which will simplify and expedite data exchange.
Output:	An annual report summarizing the nature, extent and consequences of environmental contamination on fish-eating birds (especially the herring gull) as well as scientific papers in the relevant literature.	PROJECT TITLE: GREAT LAKES SURVEILLANCE DATA MANAGEMENT
PROJECT TITLE:	WATER QUALITY DATA BASE ADMINISTRATION	Background: Water quality data are required for analysis, interpretation, reporting and international exchange on a reliable and timely basis. The components of this work include: 1. reduction and transcription of analog data to digital scientific units. 2. data conversion to computer compatible media, detailed quality control and editing of data sets using batch and on-line computer methods. 3. provision of data security and maintaining accessibility to data. 4. provision of data retrieval services on request.
Background:	The primary motivation for this project is the need to develop inter-agency and intragovernmental co-ordination with respect to data storage, retrieval and processing.	Objective: To provide scientific data reduction and archiving support to the Great Lakes Surveillance program and related research on a continuing basis.
Objectives:	To provide for the administration, integration and operational accessibility to current and historical scientific data acquired in support of the Great Lakes Surveillance program. To facilitate data analysis and interpretation, in anticipation of research requirements.	Scope: Archiving functions include: 1. co-ordination and liaison between sample acquisition and analysis agencies. 2. maintain present data and update or correct archival files. 3. process new data to be archived. 4. protect data against loss (microfilming, maintaining backup tape files). 5. document data discrepancies, anomalies, history. 6. provide data storage space. 7. catalogue data on file.
Scope:	Maintain existing programs, or enhance software systems using new EDP technology. Apply the System 2000 Data Base Management System for various internal data storage/retrieval requirements related to the surveillance program and lakes evaluation research (i.e.) STORET Data, use of SPSS. Undertake periodic reviews of data collection and data reduction programs under Canadian and joint US/Canada agreements to meet departmental objectives on an economic and timely basis.	Output: Retrieving and supplying raw or edited data on various media and using relevant selection criteria to authorized agencies or personnel. Running existing generalized programs to produce a variety of standard and custom designed data displays.

NATIONAL WATER RESEARCH INSTITUTE (NWRI)
SURVEILLANCE AND RELATED RESEARCH ACTIVITIES
1980/81

PROJECT TITLE: COASTAL ZONE TRANSPORT MODELS

Background: The Great Lakes Basin and Coastal Zone regions are prime areas of industrial development. The impact of these developments are often manifested by the transport of waste materials along the shoreline by coastal currents. It is desirable and in fact necessary to provide an objective assessment of the effects of proposed development on the coastal zone areas of the Great Lakes. The most reliable and economic way to do this is through the use of mathematical models.

Objectives: To develop and verify transport models for simulating the movements of materials in the coastal zones of the Great Lakes.

Scope: To continue development of transport models; to report on the predictive capability of these models using available environmental data; to apply the model to simulate the distribution of radioactive materials around nuclear plants.

To prepare a state-of-the-art review of transport and diffusion models with particular application to the coastal zone of the Great Lakes.

To initiate development of coastal hydrodynamical models.

To integrate with and provide the focus and computer software for related projects which include the surf-zone wave-hydrodynamics modelling work, radioactivity surveillance, the IJC and federal-provincial program on Limited Use Zones, the groundwater to surface-water interfacing models.

Output: Results will be presented in reports and journals.

PROJECT TITLE: OPTICAL MODELLING AND APPLICATIONS TO WATER RESEARCH

Background: The spectro-optical Great Lakes program (both in-situ and space oriented) are in direct accord with the priorities outlined in the Water Quality Agreement. The development of spectro-optical capabilities has resulted directly in contributions to lake water classification in terms of organic and inorganic constituents, and as such plays a potentially strong role in lake surveillance. The development of optical models based upon radiative transfer theory greatly assists the evaluation of spectro-optical data collected remotely from satellite and airborne sensors.

Objectives:

1. To develop in-situ spectro-optical models for water quality determinations from ships.
2. To continue the fabrication and evaluation of the BACH (Backscatter and Absorption Chamber) instrument and field-test the already developed BACH methodology.
3. To complete the development of water quality algorithms which may be readily applied to interpret the apparent radiance data recorded by the NIMBUS-7 satellite.
4. To develop relationships between irradiance and radiance as an aid in the determinations of energy available for primary production rates.
5. To continue development of specialized software methodology for the digital analysis and display system and apply these methodologies to spectro-optical data collected from the NIMBUS-7 and LANDSAT space vehicles.

Scope: The bulk of the spectro-optical program during this coming year will be largely directed towards theoretical model development and verification, although some data collection is intended in Lakes Ontario and Huron. Data acquired from the previous year's extensive satellite/aircraft/ship project of western Lake Ontario will be further analyzed in terms of inorganic and organic constituents. It is hoped that data from NIMBUS-7 will finally become available in an appropriate format.

Output: Results will be presented in reports and in journals.

PROJECT TITLE: STATISTICAL ANALYSIS OF SURVEILLANCE DATA

Background: A statistical approach has already been developed for the analysis of a single limnological variable. This approach will hopefully be applied to each individual variable.

Objectives: This study will be a continuation of our research program on the analysis of Lake Erie data. This study will lead to:

- 1) the assessment of the effectiveness of the present surveillance program;
- 2) the choice of an appropriate sampling design.

Scope: The method of trend surface analysis is used to develop an empirical, spatial and temporal model for each single, limnological variable. This approach will allow the determination of confidence limits of the surveillance data, examination of the spatial and temporal correlation between different variables, and the detection of changes over time or over regions within the lake. In addition, the specification of the variability pattern will allow the determination of a suitable sampling plan for future data collection.

Output: Results will be presented in reports and in journals.

PROJECT TITLE: AQUATIC ECOSYSTEMS MODELLING

Background: The ultimate goal of water management in the Great Lakes is to be able to predict lake response to any given set of conditions. To do this requires a comprehensive, predictive water quality model. The long-term goal of this project is to produce a working model of this type.

Objective: To assess the predictive capability of presently available water quality models.

Scope: Descriptive and mathematical analysis of long-term environmental data and the construction of budget balance models of phosphorus and other contaminants in Lake Erie.

To continue the development of 1-D and 2-D exchange models to simulate thermocline effects, wind-wave turbulences, sediment oxygen demand, inter-basin transports, nearshore-offshore dispersion of dissolved and suspended materials in Lake Erie.

Liaison and interfacing of activities with IJC Surveillance Work Group, Task Force on phosphorus management strategies, and other agencies.

Output: Results will be presented in scientific papers, reports and verbally at scientific conferences. It should be possible to determine where deficiencies exist and to recommend a course of action to determine the direction of future research efforts.

PROJECT TITLE: GREAT LAKES WATER QUALITY AGREEMENT STUDIES

Background: Study undertaken in response to IJC request.

Scope:

1. To develop statistical and deterministic transport models to predict dilution of contaminants around discharge sources based on coastal flow and dispersion climatologies.
2. To apply coastal zone transport models to specific discharge sources and to define "Limited Use Zones" around them (Study No. A-80-003).
3. To undertake any specific tasks related to Limited Use Zones assigned by IJC bodies.
4. To prepare a coastal current climatology summary report based on the 1979/80 Winter Thermal Plume Survey experiments at Pickering Generating Station.

Output: Results of this study will be presented in reports and will permit an objective definition of limited use zones to be made.

GREAT LAKES BIOLIMNOLOGY LABORATORY (GLBL)

SURVEILLANCE AND RELATED
RESEARCH ACTIVITIES

1980/81

PROJECT TITLE: BIOLOGICAL SURVEILLANCE ASSESSMENT AND DESIGN - EUTROPHICATION

Background: There is an obligation to develop an effective surveillance program on the issue of eutrophication, both for human use and as it affects biota. The Water Quality Board of IJC requests annual reports on the state of the lake, knowledge of areas of degradation and long-term trends on eutrophication and pollution.

Objectives: To provide information on trophic conditions of the Great Lakes on a year-to-year basis for the purpose of providing state of the lake reports, trend data, and input to scientific research. To develop aspects of the surveillance program as yet not undertaken and to rationalize those areas underway to make the best possible use of resources.

Scope: As part of the overall surveillance program lake-wide cruises will be carried out on the Great Lakes to measure eutrophication related parameters (chlorophyll a, particulate organic carbon, total particulate nitrogen, and plankton community structure) for the purpose of delineating zones of non-compliance, and potential zones of degradation. Proper development of the program with respect to parameters measured, frequency of measurement and station location will enhance statistical reliability allowing one to relate changes in trophic state to remedial action.

PROJECT TITLE: TUMOUR MONITORING IN GREAT LAKES FISH

Background: Development of a biological effects monitor is an essential component of surveillance programs and has utility as an indicator of the well-being of Great Lakes fish and as an early warning of deteriorating environmental conditions.

Objectives: To monitor tumours in Great Lakes fish for the purpose of:

1. Determining the possibility of a tumour monitoring program in conjunction with GLBL surveillance activities.
2. Establishing a tumour data base in selected areas of the lower Great Lakes.
3. Field testing the 'Tumour Identification Handbook'.

Scope: Fish will be collected and examined for tumours and morphological abnormalities from areas of Lakes Huron, St. Clair, Erie and Ontario. The sites and fish species have been selected on the basis of their proximity to suspected and known discharge sites and their importance to the fishery. Collections will continue from April through October 1980 and tissue samples will be analyzed from October 1980 to March 1981. Samples of tumour bearing fish will be analyzed by GC/MS.

PROJECT TITLE: REPRODUCTION IN GREAT LAKES TROUT

Background: Provincial and state fisheries agencies are stocking large numbers of lake trout in the Great Lakes in an effort to re-establish a self-sustaining naturally reproducing population. Recently, a small number of Lake Ontario lake trout were observed to have abnormally developed testes. The implications of these anomalies on the stocking program are unknown.

Objectives: The purpose of this study is to determine the geographical distribution and frequency of occurrence of anomalies observed in the testes of Lake Ontario lake trout and to determine if these constrictions are adversely affecting reproduction.

Scope: The geographical distribution and frequency of occurrence of abnormal testes in lake trout will be monitored by GLBL, OMNR, NYDEC and GLFL. More specimens will be collected for clinical analysis to determine sperm viability. Other Lake Ontario salmonids (rainbow trout and coho salmon) will be examined for similar anomalies.

PROJECT TITLE: CONTAMINANTS SURVEILLANCE - ASSESSMENT AND DESIGN

Background: The Water Quality Board of the IJC requests an annual report on the state of the Great Lakes, areas of degradation and the effect on Great Lakes biota with respect to contaminant burdens.

Objectives: To describe levels of trace metals and persistent organic contaminants in Great Lakes salmonids and major dietary species of fish, zooplankton and benthic invertebrates. To determine trends in contaminant levels within each of the lakes and within the entire Great Lakes System.

Scope:

1. Collection of representative top predator fish species, forage species, plankton and benthic invertebrates at a minimum of three stations on each of the Great Lakes.
2. Development of the ratio of contaminant burdens for whole fish and edible portion samples for select Upper Lakes salmonid populations.
3. Studies on the relationship of trace metal levels in scales and total body burdens.
4. Determination of levels of non-routine contaminants in Upper Lakes biota. (chlorinated naphthalenes, hexachlorobutadiene, hexachlorocyclopentadiene, chlorinated styrenes, PCT and PBB.)
5. Development of the relationship between inhibition of enzyme activity (ALA-D), blood lead levels and total body burdens of lead for several species of Great Lakes fish collected from contaminated and uncontaminated areas.

PROJECT TITLE: ALGAL HEALTH SURVEILLANCE IN THE UPPER LAKES

Background: In accordance with Annex 10, 4 of the 1978 Water Quality Agreement, this project is designed to evaluate toxic effects of contaminants in particular species of natural algal populations. The research may produce a rapid and sensitive means of evaluating contamination and will help in the interpretation of fish health as well as the overall contaminants' program being carried out at GLBL.

Objectives:

1. To develop a simple and sensitive procedure to be used as a tool in monitoring the relative response of autotrophic plankton assemblage to contaminants.
2. To conduct surveillance of algal health as reflected by suitable physiological procedures with size fractionation as the basis of partitioning.
3. To relate size/kinetics variables to species composition of natural populations.
4. To elucidate micro-morphological and cytological effects of contaminants.

Scope: The effects of contaminants on physiological processes will be monitored through various uptake kinetics parameters such as C-14, P-32, DCMU fluorescence, etc. Localization of contaminants effects within the community assemblage is carried out by size fractionation and taxonomic identification, and enumeration of species present in different size fractions of the natural planktonic assemblage. Further examination of such effects will be done by autoradiography and/or epifluorescence.

PROJECT TITLE: PHYCOLOGICAL STUDIES IN THE ST. LAWRENCE GREAT LAKES

Background: Previous studies of Great Lakes phytoplankton prior to 1970 have suffered from a number of limitations, especially the analytical techniques and the scarcity of phycologists to do reliable taxonomic identification. The monitoring of phytoplankton dates back to the early part of this century; but the data are partial and are not consistent and comparable due to the diversity and inadequacies of the procedures used. Such technique followed in the past, and some of them used even today, grossly underestimate the contribution of nanoplankton to total phytoplankton as opposed to netplankton. Therefore, a great need exists to establish a consistent and reliable phytoplankton biomass and species composition data base by standard analytical and data processing techniques and a universally accepted taxonomic nomenclature.

Objectives:

1. to develop a baseline for future phytoplankton comparisons;
2. to generate consistent data to evaluate the long-term changes of species composition in relation to nutrient conditions;
3. to provide detailed information on biomass, species and size fractions of algae which dominate the phytoplankton community;
4. to provide size analyses data to relate to community metabolism, calculate turn-over rates and get a better insight of the population dynamics;
5. to provide opportunity and data base to study interaction of flora and the environmental variables by conventional and suitable statistical procedures;
6. to develop a comprehensive and comparative overview of Great Lakes phytoplankton.

Scope: The time-consuming and meticulous taxonomic identification and enumeration of phytoplankton has been completed for surface waters on a lakewide basis. However, some information gaps exist before an overview of Great Lakes phytoplankton is attempted. Such lacking information dealing with vertical profiles and insufficient coverage, etc. is given due attention as and when the need arises from data analyses. The outline of work includes:

- (a) biomass data are analyzed first to present an overall and seasonal picture of the phytoplankton community and its composition, both horizontally and vertically;
- (b) species composition data are further related to nutrient conditions and various "indicator species assemblages" are sorted;
- (c) phytoplankton is classified into various size fractions and related to primary production rates; P/B and chlorophyll/biomass quotients are calculated to determine relative efficiency of the algal community.

PROJECT TITLE: TROPHIC STATUS OF LAKE HURON, GEORGIAN BAY AND NORTH CHANNEL

Background: To relate established indicator species to nutrients in the Upper Great Lakes and to detect new indicators, sensitive to water quality conditions.

Objectives: To study long-term changes in phytoplankton assemblages in response to water quality conditions and to establish surveillance of indicator species based on GLBL's data base.

Scope: Integrated and vertical phytoplankton samples from nearshore and offshore stations will be collected on the routine surveillance cruises of CCIW and US EPA.

PROJECT TITLE: GREAT LAKES FISHERIES SOCIO-ECONOMIC INFORMATION BASE

Background: Current surveillance activities in the Great Lakes generate information that is useful to scientists and managers, but which is somewhat obscure to most citizens and to the politicians who must ultimately make the decisions to control pollutants.

This project will attempt to collate existing economic information and social profiles relating to the fishery, and will try and interpret this information in light of the current surveillance findings.

Objectives:

1. to produce a socio-economic profile of the sport and commercial fishery in the Great Lakes.
2. To use this information in addition to the interpretation of the routine chemical and biological surveillance data generated each year.

Scope: A contract will be let for 6-7 months. This will consist of a literature search coupled with a series of meetings with Federal, Provincial, U.S. Federal and State fisheries agencies. Initial contacts with these agencies will be made through GLBL personnel. The contractor will be carrying out the bulk of the "field work".

PROJECT TITLE:

BIOLOGICAL TISSUE BANK

Background:

The 1978 Great Lakes Water Quality Agreement outlines the need for this study. Once analytical reliability is established, the determination of pesticide and non-pesticide halogenated hydrocarbons in preserved biological material will allow for the accurate retrospective monitoring of these compounds in various tissue archives.

Objectives:

To define the storage conditions required for maintaining the integrity of organochlorine residues for extended periods in a variety of biological tissues.

Scope:

1. Continuation of the study to assess the effects of frozen (-20° & -40°C) and freeze-dried storage on organochlorine compounds in coho salmon and lake trout homogenates.
2. Continuation of the study to assess the effects of storage of homogenized Mysis in the dried (predried at 60°C) and frozen (-20° & -40°C) states.
3. Initiation of a study to determine the effects on organochlorine residue levels in plankton samples stored for prolonged periods in dried (predried at 60°C) and frozen states (-20° & -40°C).
4. Initiation of a study to evaluate changes in florisil extracts of fish homogenates stored at 4°C and 20°C for various periods of time.

SECTION 2

ONTARIO MINISTRY OF THE ENVIRONMENT
GREAT LAKES SURVEILLANCE PROGRAM
1980/81

L A K E H U R O N

PROJECT TITLE: ST. MARYS RIVER

Background: Phenol levels in 1979 showed no significant changes from those in 1978. Cyanide and ammonia levels were in compliance with Agreement Objectives.

Phase I of construction at Great Lakes Power is completed. Data collected by the proponent indicated no impairment of river water quality during this stage. A monitoring program has been provided by the proponent's consultant for Phase II construction and has been approved by the Ministry. A list of "Alerting" water quality levels derived by the Ministry have been provided to the proponent, Environment Canada and the Lake Superior Water Level Control Board to measure the magnitude of impact during Phase II construction. Action plans are to be taken if the levels are exceeded.

Objectives: To assess progress of current abatement measures and the need for further remedial programs.

To assess the impact of construction activities on river quality and on the assimilative capacity of the river to disperse industrial pollutants from Algoma Steel.

Scope: As part of the international surveillance plan for Lake Huron, six cruises are planned to monitor river quality. Analyses will include; phenolic compounds, cyanide, ammonia, heavy metals, bacteria, turbidity, pH and temperature.

Output: Data will be reviewed and summarized for regional abatement staff and for inclusion in the bi-annual report to Water Quality Board.

PROJECT TITLE: SERPENT HARBOUR

Background: Serpent Harbour is the receiving water of acid sources from uranium mine activities in the upstream Elliot Lake basin. The problem is derived from bacterial oxidation/reduction of sulphide in upstream tailings disposal areas. The problem is further complicated by the low natural buffering capacity of river waters.

Objectives: To provide information on receiving water compliance with Ministry and Agreement Objectives.

Scope: Concurrent with four planned cruises for radioactivity monitoring, conventional water quality sampling will be undertaken in the Harbour using a grid of 20+ stations. Sampling will focus on analytical determinations of pH, alkalinity, nitrogens, major ions and conservative substances.

Conservative substances will be used to design a simple statistical model for radionuclide dispersion in the harbour.

Output: Input to the IJC bi-annual report.

PROJECT TITLE: SPANISH RIVER MOUTH

Background: The last intensive assessment of Spanish River mouth in 1975 indicated water quality problems associated with phenolic substances resulting from an upstream pulp and paper mill at Espanola, Ontario.

Objectives: To update water quality information from previous baseline conditions for the detection of changes.
To assess receiving water compliance with Ministry and Agreement Objectives.

Scope: The previous 1975 ULRG grid of 20 stations will be resampled for conventional water quality parameters during 2 scheduled cruises.

Output: Update report on current water quality conditions in the river mouth.

PROJECT TITLE: PENETANG - MIDLAND

Background: Previous investigations by the Ministry have indicated significant enrichment problems in Penetang and Midland Bays. Remedial measures have been undertaken including phosphorus removal facilities at the four local sewage treatment plants. Improvements are expected to occur over the long term due to the morphology of the bays which hinders mixing with Georgian Bay waters.

Objectives: Assess rate and degree of improvement of water quality in the two bays.

Scope: Sampling will be undertaken bi-weekly throughout the ice-free portion of the year. Based on assessments of past water quality data, an efficient grid of 10 stations will be sampled for a variety of nutrient enrichment parameters, and phytoplankton.

An assessment of zoobenthos will be conducted in Sturgeon Bay to document baseline conditions prior to the discharge from the Town of Victoria Harbour STP which is currently under construction. Divers will sample 15 stations twice during the year.

Output: Summary report and input to the bi-annual report to Water Quality Board.

PROJECT TITLE:	GEORGIAN BAY - NOTTAWASAGA BAY	Objectives:	to supplement data collected during 1979 on growth of attached algae and associated environmental factors (water and tissue concentrations of nutrients and selected trace contaminants)
Background:	The coastal zone of Nottawasaga Bay from Wiarton to Christian Island (Southern Georgian Bay) is currently the most sensitive area for water use and development in Lake Huron. This area currently hosts a wide variety of important water uses including fisheries; municipal water supply and waste disposal; and recreation. Within this area there are signs of local water quality degradation such as excessive algal growth in Collingwood Harbour. Recent studies in the harbour have indicated declining biomass levels resulting from a nutrient removal program at the municipal STP.		to document distribution, nutritive status and trace contaminant levels in the shoreline algae of Georgian Bay.
Objectives:	Revise and expand the environmental baseline for the bay from the previous ULRG study. Assess local and nearshore response to abatement measures and to identify any new or emerging water quality problems.	Scope:	Five sampling locations at existing and proposed STP outfall sites will be sampled bi-weekly over the ice-free period. Data collection will include algal biomass, growth rate, physio-chemical characteristics of water and substrate, algal tissue concentrations of nutrients, heavy metals and organic contaminants during three surveys (spring, summer, fall). Sampling sites are selected to coincide with ongoing surveillance programs (e.g. fish contaminant studies, water quality monitoring, etc.)
Scope:	Four synoptic cruises of the coastal zone from Wiarton to Christian Island are planned. Cruises will be scheduled to detect effects of peak annual tributary runoff in spring, peak summer recreational use and late fall lake turnover. Nearshore stations will be sampled on transects with station density intensified near harbours, point sources and tributaries. Sampling effort will include local assessments at Wiarton, Owen Sound, Meaford, Thornbury, Collingwood Harbour and off Nottawasaga river mouth (Wasaga Beach). The bulk of this project relates to conventional in-situ water quality sampling for nutrients, biomass, physical and public health bacteriological parameters. Phytoplankton sampling will be carried out during all cruises at selected stations from the main survey grid. This study will be complemented by other specialized surveys for <u>Cladophora</u> , intake sampling, benthos and sediments as outlined in other project descriptions.	Output:	Ministry reports and input to the I.J.C. bi-annual report.
Output:	Input to IJC bi-annual Report	PROJECT TITLE:	LAKE HURON, GEORGIAN BAY AND NORTH CHANNEL NEARSHORE SEDIMENT AND BENTHOS
PROJECT TITLE:	GEORGIAN BAY ATTACHED ALGAE INVENTORY	Background:	Sediment and benthos sampling are cost-effective tools for the early warning and detection of water quality degradation particularly when related to the trace contaminants and nutrient enrichment issues. There are no recent systematic baseline data on benthos populations throughout the Canadian coastal zone of Lake Huron, Georgian Bay and the North Channel. Historical benthos data are available but tend to be of a limited and site-specific nature.
Background:	The southern Georgian Bay area has been designated for major development (Task Force Dev. Strat. 1976). Increased municipal, industrial and recreational use in the Waubesa to Meaford area has already resulted in plans for additional sewage treatment facilities (e.g. Collingwood Township, Wasaga Beach, Victoria Harbour). It is probable that widespread proliferation of <u>Cladophora</u> and other algae will result if additional inputs of treated sewage effluent are permitted. Studies by MOE in 1979 in southern Georgian Bay showed that areas of excessive algae growth currently exist adjacent to well defined sources of nutrients (i.e. river mouths, STP outfalls). An increase in ambient phosphorus concentrations of few ug P/L over the whole lake basin could stimulate the ubiquitous growth of attached algae with possibly extensive and irreversible damage to fish production (whitefish and smallmouth bass), water quality and shoreline aesthetics in an area which depends heavily on tourism and recreational patronage. There is an urgent need to document the seasonal distribution, abundance and nutritive state of filamentous algae throughout Georgian Bay. This information, along with data on trace contaminant levels in algal tissue will provide a baseline against which future changes can be evaluated. The data will also be useful in the development of policy relating to the siting of STP outfalls in Georgian Bay.	Objectives:	To provide a systematic baseline of biological nearshore conditions for the evaluation of trends. To assess the effect of localized inputs to embayments and harbours.
		Scope:	This study is divided into two components i) nearshore conditions and ii) local conditions related to specific discharges. Nearshore sampling will be based on inshore/offshore transects located in areas of active sedimentation, areas of important fisheries habitat as well as areas of known environmental sensitivity. In addition to benthos sampling, sediments will be partitioned for physical testing and analysis for heavy metals and organic trace contaminants. Emphasis will be placed on nearshore transects in the southern Lake Huron Basin, southern Georgian Bay and the North Channel at the mouth of the St. Marys River. For local studies, more intensive station grids will be sampled. Local sites include Sturgeon Bay and Collingwood Harbour. Sampling and benthos enumeration will be completed using contract services. Laboratory analysis for metals and organics will be undertaken by the Ministry.
		Output:	Input to the IJC bi-annual Report.

PROJECT TITLE: NEARSHORE LAKE HURON

Background: Under GLISP, Lake Huron is designated for intensive surveillance activities during 1980. Water quality issues along the Canadian coastal zone of Lake Huron, Georgian Bay and the North Channel can be classified into two general categories including:

Large scale nearshore areas where baseline water quality conditions range from good to excellent. These areas currently do not show signs of environmental stress and are those where the "non-degradation" philosophy as outlined in the Upper Lakes Reference Group (ULRG) final report is applicable and,

Localized areas of water quality degradation such as harbours or embayments that are influenced by controllable point sources and/or diffuse sources such as tributaries.

Objectives: Delineate the nature and extent of non-compliance; if any, with the 1978 Agreement and MOE Water Quality Objectives.

Update prior environmental baseline data of the ULRG for the Canadian coastal zone of Lake Huron.

Scope: Three cruises are scheduled for Lake Huron. Water quality sampling will focus on zonal station grids at the mouths of the Ausable, Saugeen, and Maitland Rivers and intake verification transects at the Goderich and Grand Bend intakes. Parameters to be measured included nutrient chemistry, chlorophyll, conservative substances, and public health bacteria.

Output: Input to the IJC bi-annual Report to Water Quality Board.

PROJECT TITLE: LAKE HURON INTERLAKE MASS BALANCE

Background: Under Annex 3 of the 1978 Agreement the Ministry will continue to determine accurate phosphorus loadings to and from Lake Huron.

A previous study at the Lake Huron outlet (head waters of the St. Clair River) indicated that frequent monitoring is required due to water quality variations resulting from spring runoff, phytoplankton annual cycle, and thermal regimes of the lake.

Objective: To provide an estimate of phosphorus and other nutrient inflow/outflow loading relationships for Lake Huron.

Scope: Under contract(s) the head ranges of the St. Marys and St. Clair rivers will be sampled intensively once a week throughout the ice-free period of the year. Samples will be analyzed for a variety of mass balance parameters including phosphorus, nitrogens and conservative substances. Laboratory analyses will be performed by the Ministry.

Output: Study findings including the mass balance estimates will be forward to Surveillance Work Group for inclusion in the bi-annual report to the IJC.

LAKE ERIE

PROJECT TITLE: ST. CLAIR RIVER

Background: The St. Clair River Organics study is complete and several reports are available.

Other reports dealing with the identification of dissolved organic compounds and the impact on fish tainting are underway. Findings indicate that significant improvements have taken place during the last decade. Remedial measures undertaken at municipal and industrial sources are major contributions to the observed improvements.

A local bacteriological problem in Sarnia Bay has resulted in beach closure during recreational periods. This problem is due to storm and sanitary bypass sewers.

Objectives: Maintain surveillance of phenolic compounds in the river to assess the progress of remedial measures.

Assess the effect of storm and sanitary bypass discharges on the bacteriological water quality of Sarnia Bay and to identify remedial actions required.

Scope: One cruise is scheduled for the sampling of phenolic compounds in the river. Emphasis will be focused on the area near the major source of these compounds. A total of 300 samples will be sent to the London and Toronto laboratories for inter lab comparison. In addition, nutrient and dissolved organic carbon will be measured.

Public health microbiological indicators will be sampled along the Sarnia Waterfront during two cruises (spring and summer). Approximately 150 samples will be collected during each cruise. Staff of MOE London Regional office will liaise with the city for the collection of two to three sets of samples during storm events at the storm and sanitary bypass sewers.

Output: Report to MOE Regional staff and input to the bi-annual report to Water Quality Board.

PROJECT TITLE: DETROIT RIVER SEDIMENT AND BENTHOS

Background: The Detroit River hosts a large concentration of water uses including recreation, water supply, waste disposal and commercial navigation. The river is a significant habitat for wildlife and is a major migratory route of passage for several important commercial and sport fish species (eg. walleye). Recent studies in other Great Lakes connecting channels (eg. Niagara and St. Clair Rivers) have led to growing concern as to the fate and waterborne transport of trace contaminants in the Great Lakes ecosystem. Since the shoreline of the Detroit River constitutes the greatest density of industrial water use in the Great Lakes Basin, it is imperative that surveillance be directed to such important issues as trace contaminants. This plan is designed under the Lake Erie International Surveillance Plan as a specialized problem area study.

Objectives: To update the previous 1969 MOE (OWRC) baseline assessment of macrozoobenthos.

To define the current health of the benthic community of the Detroit River and identify areas of existing or emerging water quality problems with respect to trace contaminants.

Scope: The original 1969 OWRC/MOE station grid based on 50 stations on IJC river transects will be re-sampled for benthos and sediment analysis. Benthos samples will be sorted and enumerated in the living state. Replicate sediments will be subjected to analysis for heavy metals, PCBs, chlorinated pesticides and physical composition. This is a joint study with MOE S.W. Regional Office in London.

Output: Project report with a comparative evaluation of previous OWRC/MOE data.

PROJECT TITLE: NANTICOKE

Background: Large-scale industrial development is taking place in the Nanticoke coastal region of Long Point Bay. To protect water quality, chemical, biological and physical conditions have been monitored since 1968 by the Nanticoke Environmental Committee, representing MOE, MNR, Ontario Hydro, Stelco and Ixaco. The monitoring will continue until 1984.

Objectives: Maintain surveillance of the impact of increased municipal and industrial development at Nanticoke.

Scope: Water quality, phytoplankton and zooplankton will be monitored on 15 cruises at 6 stations from mid-April to November. Currents will be measured at Centre Creek, which serves as the outfall for Stelco's effluent. Fish studies will be done by MNR and water temperature monitoring by Hydro.

Output: Annual reports on the individual studies. Reports summarizing the findings of individual studies since the beginning as well as a report integrating all studies are under preparation.

LAKE ONTARIO

PROJECT TITLE: NIAGARA RIVER

Background: The input of many persistent toxic contaminants from industry and waste disposal sites in New York State and their possible effects on Ontario water users has received much attention over the last year. Studies in 1979 revealed elevated levels of heavy metals and organochlorine compounds in Niagara River suspended sediments. The effect of these contaminants on aquatic habitat and drinking water, requires further in-depth investigation.

Objectives: Determine sources of persistent toxic contaminants in the area.

Assess the impact of discharges on water and suspended sediment quality and biota in the lower Niagara River.

Investigate biomagnification of persistent toxic contaminants in biota.

Scope: A number of cruises will be carried out in the Niagara River with emphasis on water, suspended sediment, sediment, and biota. These studies will be carried out in conjunction with the Ministry's young-of-the-year fish sampling program as well as in co-operation with the Canada D.F.E. suspended sediment study and the Niagara-on-the-Lake water intake program. Assessment of sources will be co-ordinated with the Ministry's Regional office and with the New York D.E.C.

Output: Ministry reports, including findings and recommendations, will be forwarded to regional staff and concerned agencies by early 1981.

PROJECT TITLE: NEARSHORE LAKE ONTARIO

Background: Previous studies have indicated that nutrient levels in the nearshore zone of Lake Ontario are sufficiently high to induce localized phytoplankton blooms and prolific Cladophora growth where suitable substrate exists. Recent analyses have shown the existence of regional differences in water quality of the nearshore. Five statistically different regions were identified between Niagara River mouth and Port Hope. Recent investigations have identified a pronounced inshore-offshore gradient in water quality; distinct vertical partitioning of nutrients and phytoplankton under stratified conditions; and a potentially significant contribution of nutrients from sediments and littoral drift. These findings have a significant bearing on future assessments of shoreline developments and on the interpretation of phosphorus management models.

Objectives: Define regional differences in water quality of the nearshore with emphasis on trophic status definition.

Detect trends in nutrient levels and algal biomass in response to phosphorus abatement measures.

Provide a continuing stream of data to aid in the early detection of emerging problem areas and environmental issues.

Scope: One cruise (consisting of triplicate sampling) will be undertaken in the spring of 1980 in the nearshore zone between the Niagara River mouth and Kingston. A system of transects extending from shore to the 50m depth contour will be monitored for nutrients and associated water quality parameters. This component will define regional differences in nearshore water quality and detect emerging problem areas.

One of five documented water quality regions will be monitored weekly throughout the ice-free period, along a representative transect.

To aid the interpretation of water quality information a system of in-situ continuous temperature recorders will be installed at one station to monitor upwelling/downwelling frequency. All stations along the transect will be monitored weekly, with depth, for nutrients and associated parameters. This component of the program will provide information for the assessment of nearshore trends in water quality and trophic status.

Plankton will also be sampled to assess the potential of the nearshore zone for phytoplankton production in relation to nutrient availability and to detect long term changes in phytoplankton zooplankton population structure. Selected transect stations will be sampled for plankton which will be speciated and enumerated. Concurrent primary productivity and heterotrophy studies will be carried out to detect differences in nutrient assimilation between two different nearshore regions and between inshore-offshore regimes.

A baseline study documenting sediments and benthos located along transects will be initiated. The sediment-water interface will also be studied to assess the degree of nutrient contribution from sediments and/or littoral drift to the water column.

Output: Information from these investigations will be used to update problem area and general assessments of Lake Ontario in the bi-annual report to Water Quality Board.

PROJECT TITLE: HAMILTON HARBOUR

Background: Previous intensive studies of Hamilton Harbour have identified a number of problems associated with past and present industrial and municipal discharges.

Harbour sediments harbour are heavily contaminated and act as a potential source of heavy metals, organic contaminants and nutrients. A severe oxygen depletion problem occurs during the summer months. The oxygen depletion process appears to have been partially offset by artificial mixing conducted by M.O.E. during the 1975-1978 period and vortex mixing initiated by McMaster University in 1977.

The aeration project was discontinued in 1979 in order to assess its effectiveness.

Objectives: Assess the importance of ammonia, dissolved organic carbon and reduced sulphur compounds in the process of oxygen depletion.

Determine chemical zonation and limited use zones in the harbour.

Determine the relative magnitude of storm sewer loadings to the harbour.

Determine dispersion and circulation characteristics of the north-east section of the harbour.

Scope: Loadings to the harbour from combined sewers will be determined after storm events. The process of oxygen depletion in water and in sediments will be investigated, especially the roles played by ammonia, dissolved organic carbon and sulphur compounds. Regular chemical limnology surveys will be continued as well as intensive surveys for zonation and limited use zones.

Predictive statistical and block models will be developed to study the effects of changes in loadings on oxygen concentrations. Dye and drogue studies and aerial photography will be used for circulation studies.

Output: Ministry reports including findings and recommendations to be forwarded to regional abatement staff and other involved agencies. A summary report by March 1981 summarizing all data and findings gathered since the study began in 1973.

PROJECT TITLE: TORONTO HARBOUR

Background: Intensive studies conducted in 1978 and 1979 have delineated the extent of water quality impairment associated with the Don River and the city storm and combined sewer overflows.

During 1980 a landfill endikement is being constructed on the Outer Harbour East Headland for disposal of Keating Channel (Don River mouth) contaminated dredge spoil.

A potential problem of heavy metals and trace organic contamination still exists in the sediments of the harbour. The effect of these contaminants on resident biota is unknown.

(1) Objectives: Assess the effectiveness of remedial measures on water quality in the harbour.

Document further changes as a result of anticipated reduction in loadings.

Scope: Three stations (representing inner harbour, outer harbour and Island Filtration Plant intake area) will be monitored daily during the ice-free period to detect seasonal changes in water quality.

Specific point source discharges will be monitored twice weekly throughout the year to assess their loading contribution to the harbour. Routine Beach monitoring will be conducted from May to September. This study is done in co-operation with the City Public Works Department and the City Public Health Department.

Output: Ministry reports will be prepared in 1981, including findings and recommendations, to be forwarded to regional abatement staff and other involved agencies.

(2) Objectives: Investigate biomagnification of heavy metals and organic trace contaminants in biota and establish accumulation ratios for, plankton, sediments, invertebrates, fish and macrophytes.

Scope: Selected stations in the Humber Bay, inner harbour, Island Lagoons, outer harbour and Main STP outfall will be investigated in order to assess the relative severity of the contaminants problem in the Toronto area. At each station water, plankton, sediments, benthos, fish and macrophytes will be analyzed for heavy metal and organic trace contaminant content. Body burdens will be established for affected biota.

Output: The results of this study and recommendations will be communicated to the Region and concerned agencies. A ministry report will be prepared in 1981.

(3) Objectives: Investigate impacts of landfilling and dredge spoil disposal activities and assess interactions from these sources with STP discharge effects.

Scope: Synoptic surveys will be conducted throughout the field season around the active landfill disposal site. This will be done in conjunction with plume studies at the Main STP.

Output: Data will be used primarily in Ministry progress reports to Regional staff.

(4) Objectives: Determine the currents at the proposed location of the new outfall of the main Toronto sewage treatment plant.

Scope: Surface and a bottom current meters will be maintained for a period of a year.

Output: Data in the form of current summaries will be used in estimating the dispersion characteristics from the existing and proposed outfalls.

PROJECT TITLE: LAKE ONTARIO - EASTERN SECTOR OXYGEN DEPLETION

Background: In the past few years, main lake surveillance has detected an oxygen depletion problem in Lake Ontario east of Prince Edward County. Oxygen levels have been observed to drop below 6 mg/l in the hypolimnion by mid-August and to persist until early September. The areal extent of the problem is insufficiently documented, at present.

Objectives: Define the areal extent of the oxygen depletion problem.

Scope: Four cruises will be undertaken between mid August and early September in the deep portions of the basin east of Prince Edward County and in Adolphus reach. Extensive vertical profiling of temperature and dissolved oxygen will be conducted.

Output: Update of the problem area assessment in the bi-annual report to Water Quality Board.

PROJECT TITLE: BAY OF QUINTE

Background: Water uses in the Bay are being adversely affected by nutrient enrichment. There have been occasions where little or no dissolved oxygen was present in the deep waters of the Bay. Bacterial contamination resulting from inadequate municipal treatment facilities has restricted recreational activities in some areas. A number of steps have been taken in improving municipal treatment facilities. Trenton and Picton have completed plant expansions. Belleville is planning to expand facilities and expansion at Napanee is under construction. Treatment at Deseronto will include phosphorus removal.

Objective: Monitor the changes in water chemistry and phytoplankton in the Bay as phosphorus reductions at sewage treatment plants come online.

Assess progress in correcting bacteriological conditions.

Scope: This is a joint study with Fisheries and Environment Canada, Ministry of Natural Resources, universities of Guelph and Queen's. Virtually all aspects of the limnology of the Bay of Quinte are under study.

Output: Annual reports are published incorporating material from all study team members. The data for the next two years will be important since phosphorus reductions are now in effect at all major plants.

PROJECT TITLE: ST. LAWRENCE RIVER - CORNWALL

Background: Ministry studies of the proposed Cornwall STP expansion and the existing sewer system have revealed significant overflow problems to the St. Lawrence River. Present data indicate bacterial contamination along the city waterfront and downstream. Remedial measures are being developed to alleviate overflow and treatment problems.

Objectives: Document existing sources and extent of bacterial contamination under different seasonal and overflow conditions.

Assess extent of industrial discharge effect for selected contaminants.

Scope: Several bacteriological cruises will be conducted from spring to fall along the St. Lawrence River shoreline at Cornwall and downstream. River surveys will be conducted in conjunction with source and beach monitoring.

This is a joint study with MOE Southeast Region and the local Health Unit. Analysis for industrial contaminants will be initiated as required.

Output: Ministry reports forwarded to MOE Regional staff as input to remedial measures planning.

GENERAL

PROJECT TITLE: ENVIRONMENTAL ASSESSMENTS

Background: In 1979/80, Great Lakes Surveys Unit staff spent an estimated 80 man-weeks (exclusive of field activities) on the assessment of proposed new and expanded waste treatment facilities, water supply problems and shoreline development proposals.

There were 40 + individual assessments handled during the year which is approximately 3 times the number undertaken in the previous year. This change reflects an increasing demand for the specialized knowledge of the Great Lakes and for the expertise in predictive modelling and statistical interpretation of data which exists within the unit. It also indicates that substantial progress is being made in tying abatement and assessment activities more closely together as a result of the "Blue Book".

Objectives: To provide Regional Abatement and Utilities Operations staff and Environmental Approvals and Project Co-Ordination Branches with technical and scientific guidance in site selection, effluent requirements and design criteria for new and expanded industrial and municipal water and wastewater treatment facilities and for proposed shoreline developments such as landfills.

Scope: Most assessments are carried out through an evaluation of existing receiving water data and water use information supplemented as necessary by the current year's monitoring data. Extensive use is made of trend analyses, one- and two-dimensional dispersion models and site-specific water quality criteria. All requests for assessments will be handled as priority items.

Output: Individual assessment reports on a case-by-case basis.

PROJECT TITLE: LIMITED USE ZONE DESIGNATION

Background: Per Annex II of the 1978 Great Lakes Water Quality Agreement, MOE is required to designate LUZ's for Canadian industrial and municipal discharges to the Great Lakes. The Ministry has designated LUZ for the following industries.

Pulp and Paper Mills: (Lake Superior)
 Abitibi Paper Co. (3 mills)
 Kimberly-Clark
 American Can of Canada Ltd.
 Domtar Packaging Ltd.

Petrochemical: (St. Clair River)
 Imperial Oil Ltd.
 Polysar
 Dow Chemical
 SunCor
 Shell
 Petrosar
 Ethyl Corp
 Du Pont

Steel Mill: (St. Marys River)
 Algoma Steel

These designations are currently under review by the industries.

Objectives: Report to the IJC LUZ designations by June 1980.

Refine procedures for the determination and monitoring of LUZ's.

Scope: The LUZ for municipal discharges will be determined using available dispersion models together with effluent requirements and receiving water characteristics. These designations will be completed by early May.

LUZ's for the remaining industrial discharges will be completed in late 1980.

Output: A report to the IJC outlining detailed descriptions of each LUZ.

Data summaries for each location.

Report on guidelines and procedures for the designation of LUZ.

PROJECT TITLE: STRATIFIED TRIBUTARY MONITORING

Background: Tributary loading information is an essential component for mass balance calculations as well as providing input for modelling the phosphorus remedial measures program in the Great Lakes basin. This information, provided annually to Surveillance Work Group, has been traditionally derived from a marginal data base.

A program began in 1979 to improve loading estimates for selected Great Lakes tributaries. This information will be used in the loading allocation scheme under the 1978 Great Lakes Water Quality Agreement.

Objectives: To enhance the precision of tributary loading estimates for significant tributaries.

Scope: Stratified water quality sampling techniques have been employed at 13 stations on the tributaries of "major" significance. Local contract samplers are used with technical backup from regular staff. Two monitoring stations will be added in 1980.

Samples of suspended sediment and streambed material will also be collected and analyzed to initiate an inventory of trace contaminants by watershed.

Information obtained will be used to optimize the allocation of sampling in the future.

Output: Improved annual loading estimates will be calculated using a computerized multi-strata loading model with results provided annually to Surveillance Work Group.

PROJECT TITLE: CONTAMINANTS IN YOUNG-OF-THE-YEAR FISH

Background: While control of some contaminants has produced declines in contaminant residue levels in nearshore fish, the need still exists to monitor future contaminant trends in the Great Lakes. There is also a need to assess the biological impact of contaminants presently not considered in routine fish analyses.

Existing spottail shiner residue data have proven useful for trend detection in the Great Lakes. There is a need for additional data on contaminant uptake variability to improve the interpretation trends.

Objectives: Isolate problem areas for point-source identification.

Update the fish residue data base for contaminant trend monitoring.

Determine seasonal variability of contaminant uptake associated with specific life stages of spottail shiners.

Scope: Nearshore fish collections will be made at selected sites on the Great Lakes. In order to maintain spatial and temporal comparability young-of-the-year spottail shiners will be retained as the principal test species. In addition to regular organochlorine analyses, chlorinated benzene, phenol, styrene and butadiene residue concentrations will be determined. Analyses of these additional contaminants were started on a limited scale in 1978/79 and the results suggest that further work is warranted. It is also proposed that spottail shiner samples be collected for radionuclide analyses at Pickering, Port Hope and Bruce.

For the assessment of seasonal variability, sampling of spottail shiners will be undertaken at a single site (Humber River) at the earliest time possible for young fish capture. Periodic sampling will be continued throughout the active growth period. Residue analyses will be done for whole fish composites and related to weight, size and lipid content.

Output: Ministry reports will be forwarded to regional and other agencies by early 1981.

PROJECT TITLE: CONTAMINANTS IN SPORT FISH

Background: Since the late 1960's the Ontario Government has been monitoring fish from Ontario watercourses.

In July 1977, the Ontario Government compiled and published comprehensive information on lakes monitored since the program began.

Fish collections are continuing and data on fish species from many lakes are available in reports entitled "Guide to Eating Ontario Sport Fish".

Objectives: Maintain surveillance of known contaminant levels and identify sources of contaminants inputs by utilizing resident fish species.

Scope: Fish collection and testing is a joint program of the Ministries of Environment and Natural Resources. Fish will be collected from sites along the Ontario shoreline of the Great Lakes. Whenever possible the collection includes 15 to 30 fish of each species representative of the size range from the lake being tested. Length, weight and sex are recorded.

Output: Environmental Health Bulletins are issued on a monthly basis. "Guide to Eating Ontario Sport Fish" is updated annually.

PROJECT TITLE: WATER INTAKES

Background: Sampling of raw waters at municipal water supplies in the Great Lakes has proven to be a cost-effective surveillance program for the assessment of trends. Weekly monitoring for aquatic chemistry and phytoplankton has been in effect at eleven municipal water treatment plants since 1976. Historical phytoplankton data also exists for a few sites for more than ten years.

Objectives: To measure seasonal changes and multi-year trends in aquatic chemistry and phytoplankton in the nearshore zone of the Great Lakes.

Scope: Sampling will continue at three intakes in Lake Huron, one in the Detroit River, four in Lake Erie, two in Lake Ontario and two in the St. Lawrence River. Last year three intakes were added including, Grimsby and Cobourg, Lake Ontario, and Terrace Bay in Lake Superior. This year, as part of the Lake Huron International Surveillance Plan, three intakes are being added including Gore Bay, North Channel; and Meaford and Collingwood in Georgian Bay. All locations are sampled weekly for phytoplankton, nutrient chemistry, and conservative substances.

On an experimental basis, selected intakes will be used to assess the feasibility of using filter backwash of suspended solids as a sampling technique for trace contaminants. Recent studies such as PLUARG, indicate that trace contaminants are strongly associated with suspended organic and inorganic solids. Samples will be analyzed for metals, pesticides, PCBs and mirex.

Output: Regular program data are summarized annually and significant findings reported (MOE reports, input to WQB bi-annual report).

A report outlining the feasibility of using filter backwash solids as a surveillance tool for trends in trace contaminants will be available at completion of experimental studies.

PROJECT TITLE: BIOLOGICALLY AVAILABLE PHOSPHORUS

Background: Phosphorus is the most important chemical factor governing the degree of enrichment of most Ontario lakes. Of the forms of phosphorus routinely measured (total and soluble reactive phosphorus) it is not clear exactly as to which portion is biologically available (BAP).

A simple method of measuring the biologically available phosphorus content of water samples would be extremely valuable for improved predictive abilities of phosphorus loading, algal biomass and oxygen depletion models.

Objectives: To continue the development of a radiobioassay technique to measure the BAP content of waters.

Scope: Considerable progress occurred in the past year in developing this method. BAP measurements for several different types of STP and marsh-treated effluents will be initiated on a trial basis.

Output: MOE report and technical paper.

PROJECT TITLE: RADIOACTIVITY MONITORING

Background: There are six known locations in the Ontario coastal zone of the Great Lakes where radioactive releases exist or potentially exist. These areas by type of processing include:

Uranium Mining - Serpent Harbour, North Channel

Uranium Refining - Port Hope, Lake Ontario
- Port Granby, Lake Ontario (ENL Dump),
- Wellcome, Lake Ontario (ENL Dump).

Heavy Water Reactor - Bruce Nuclear Power Development (BNPD), Lake Huron.
- Bruce 'A' G.S., Lake Huron and Douglas Point G.S.- Lake Huron
- Pickering 'A' G.S. - Lake Ontario

Previous Monitoring for Serpent Harbour - North Channel has indicated ^{226}Ra levels frequently approach or exceed the Ministry Objective for public water supply (greater than 3 pCi/L).

In recent years, the radioactivity Sub-committee of Water Quality Board, IJC has addressed the issue of co-ordinated surveillance of waterborne radionuclides in the Great Lakes. A radioactivity surveillance plan has been prepared which is outlined in Appendix D of the 1975, 1976, 1977 and 1978 annual reports of the Sub-committee as well as the Great Lakes International Surveillance Plans prepared by Surveillance Working Group. The 1978 Canada-US Agreement on Great Lakes Water Quality outlines a specific objective for radioactivity based on total body dose to man.

Objectives: To provide surveillance information for specific radionuclides for the source control area (SCA) component of the International Radioactivity Surveillance Plan for those areas of potential or existing radioactive releases in the Ontario coastal zone of the Great Lakes.

Scope: Radioactivity surveillance of source control areas in the Great Lakes is an ongoing program. Full laboratory support for the IJC program is now available from MOL. The large sample volume requirements (17 L/STN.) as recommended in the surveillance plan will be implemented this year.

Output: Radioactivity surveillance data will be compiled and reported in the reports of Radioactivity Sub-committee (Appendix D) as well as being circulated within MOE and MOL.

PROJECT TITLE: DREDGE AND SPOILS DISPOSAL

Background: Concern for environmental effects of the disposal of contaminated dredged spoils in open water caused Ontario and other Great Lakes jurisdictions to require careful selection of disposal sites and in many cases to require contained disposal. Because of the much higher cost involved in developing and operating a contained disposal area, and because such sites are often not immune to their own set of adverse environmental effects, support is growing among proponents and others for an analysis of costs/benefits of contained vs. open-water disposal.

Research by the U.S. Corps of Engineers has suggested that the effects of open-water dumping may not be as great as earlier thought. However, much of this earlier work is not directly applicable to the Great Lakes environment.

Objectives: To provide the basis for the Ontario position on continuation or modification of its contained disposal requirements through in-situ investigation of a limited number of both open-water and contained disposal operations.

Scope: In-situ investigations on the effects of suspended solids, nutrients and contaminants on water quality and phytoplankton.

Investigations will include the assessment of the impact of spoils disposal on water chemistry, light transmission, phytoplankton, sediment chemistry and benthos. An attempt will be made to determine the cause of observed detrimental effects (i.e., whether they relate to physical mechanisms such as screening or blanketing, or to the presence of dissolved contaminants or nutrients). Study locations will be determined upon receiving public and private dredging proposals for 1980.

Output: A report outlining findings at various sites under investigation and recommendation; if any, for changes to existing Ministry policy and guidelines for dredged spoils disposal.

PROJECT TITLE: REMOTE SENSING

Background: The utility and benefits of remote sensing techniques as complementary tools to conventional in-situ water quality studies have been shown over the past few years. Work to date has focused on the application of far infrared imaging techniques to map thermal plumes from steam electric cooling plants.

Additional activity has focused on the application of airborne multispectral photography for *Cladophora* mapping and the use of archival imagery for field planning purposes.

Objectives: To further develop cost-effective remote sensing techniques which complement conventional in-situ surveillance techniques.

Scope: A variety of activities are forecasted for this year including:
(i) further development of digital image analysis techniques using low altitude infrared linescanner data;
(ii) finalization of the analysis and reporting of low altitude ART (airborne radiation thermometer) surveys of the Pickering 'A' G.S., Lake Ontario winter thermal plume.
(iii) preparation of lower Great Lakes coastal zone colour airphoto mosaics.

Output: A variety of products including mosaics, maps and a brief technical document on winter thermal plumes off the Pickering 'A' G.S., Lake Ontario.

PROJECT TITLE:	DATA ANALYSIS	Scope:	During 1980 a variety of major improvements to the SIS are planned resulting from the implementation of the Laboratory Information System (LIS) at the MOE Main Laboratory. The LIS will streamline the flow of field and laboratory data using a computer to control laboratory information. As a result of the implementation of the LIS, the SIS data management software will be modified. Such modifications include the implementation of a new and enhanced parameter description file. Since the LIS will eliminate present manual compilation, editing and key punching of Great Lakes data into the SIS, it is anticipated to focus greater intention on quality control and editing of both current and historical data on the system. Further expected improvements include a reduction in turnaround time for laboratory data to the computerized master file.
Background:	Over the past several years, computerized data analysis has formed a fundamental operational component in the reporting of water quality information. This activity can be grouped into two general categories including production data analysis using proven analytical methods and software; and developmental data analysis including the development and testing of new techniques and software. This component is designed to ensure timely and cost-effective reporting of data collected under the International Great Lakes Surveillance Plans.		
Objectives:	<p>To provide fiscal support for computer time, software (development, maintenance, and purchase) and enhancements to computer input/output hardware as required for data analysis support for reporting.</p> <p>To provide technical support for data analysis including statistics, modelling, computer mapping and graphics.</p>	Output:	Information retrieval services, including formatted computer tapes, parameter and station summaries and COM.
Scope:	<p>A wide variety of tasks are included in this project including:</p> <ol style="list-style-type: none"> (1) Production data analysis using operational software tools such as 2 WAY-ANOVA, SYMAP, SPSS, TEKTRONIX (TCS and AG II), LUZ Model Library and ASPEX. (2) Development, testing and implementation of new statistical, graphical and numerical analysis techniques. (3) On demand case applications programming. (4) Aquisition and maintenance of computer hardware. (5) Maintenance, modification, optimization and documentation of existing data analysis software. (6) Participation in technical meetings and reporting related to data analysis. 	PROJECT TITLE:	REQUESTS FOR INFORMATION
Output:	Tabular and graphic input to a variety of MOE reports on water quality; software documentation; seminars; and technical reports.	Background:	The need for information on the suitability of Great Lakes waters for municipal and industrial water supply, recreation and fishing etc., and growing concern for pollution problems has resulted in an extraordinary number of request for data, information and advice. Requests come from the public, industry, consultants and other government departments.
PROJECT TITLE:	DATA MANAGEMENT	Objectives:	To meet the information needs of the requestor in an efficient and timely manner.
Background:	Data management is a fundamental component of the Great Lakes Surveillance program. This project relates to those collective activities involved in the systematic editing, storage, retrieval, updating and cataloguing of data collected under MOE's component of the International Great Lakes Surveillance Plans. This includes storage on both non-electronic and electronic storage systems. The bulk of MOE's historical Great Lakes water quality data (currently estimated greater than 170 million characters) is stored in the Province's computerize environmental storage and retrieval system known as the Sample Information System (SIS). During 1979, the implementation of COM - Computer Output Microfiche was completed for SIS - Great Lakes Water quality retrievals. COM format is now the preferred media for information exchange to external users.	Scope:	It is anticipated that some 300 + requests will be received in 1980/81 and that these will be dealt with using existing data and information.
Objectives:	<p>To provide fiscal and resource support for the maintenance, quality control, update and operation of the Great Lakes component of the Sample Information System.</p> <p>To provide data and information retrieval services to support reporting as well as the information requirements of a wide client base including members of the International Great Lakes Water Quality Surveillance Community.</p>	PROJECT TITLE:	I.J.C. SUPPORT
		Background:	The Canada/Ontario Agreement commits the Ministry to providing continuing scientific and technical staff support to the International Joint Commission, its advisory boards and committees.
		Objectives:	To fulfill commitments made under C.O.A.
		Scope:	<p>Ministry staff employed in the Great Lakes Program will sit on, and/or provide scientific, technical, secretarial and clerical support to, the following:</p> <p>Water Quality Board Science Advisory Board Surveillance Work Group Lake Work Groups Data Interpretation and Management Work Group</p>
		Output:	Preparation of International Surveillance Plans WQB bi-annual Report and special assignments requested by the I.J.C. or its boards.

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